Sublethal Effects of Contaminants Regularly Detected in the Delta: Risks to Smelt

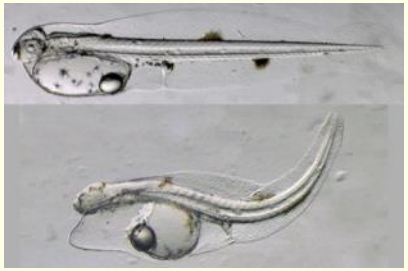

Image: John Incardona, NOAA.

Image: Bethany Decourten, UNCW.

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Chapter 7 - Contaminant Effects on California Delta Species and Human Health:

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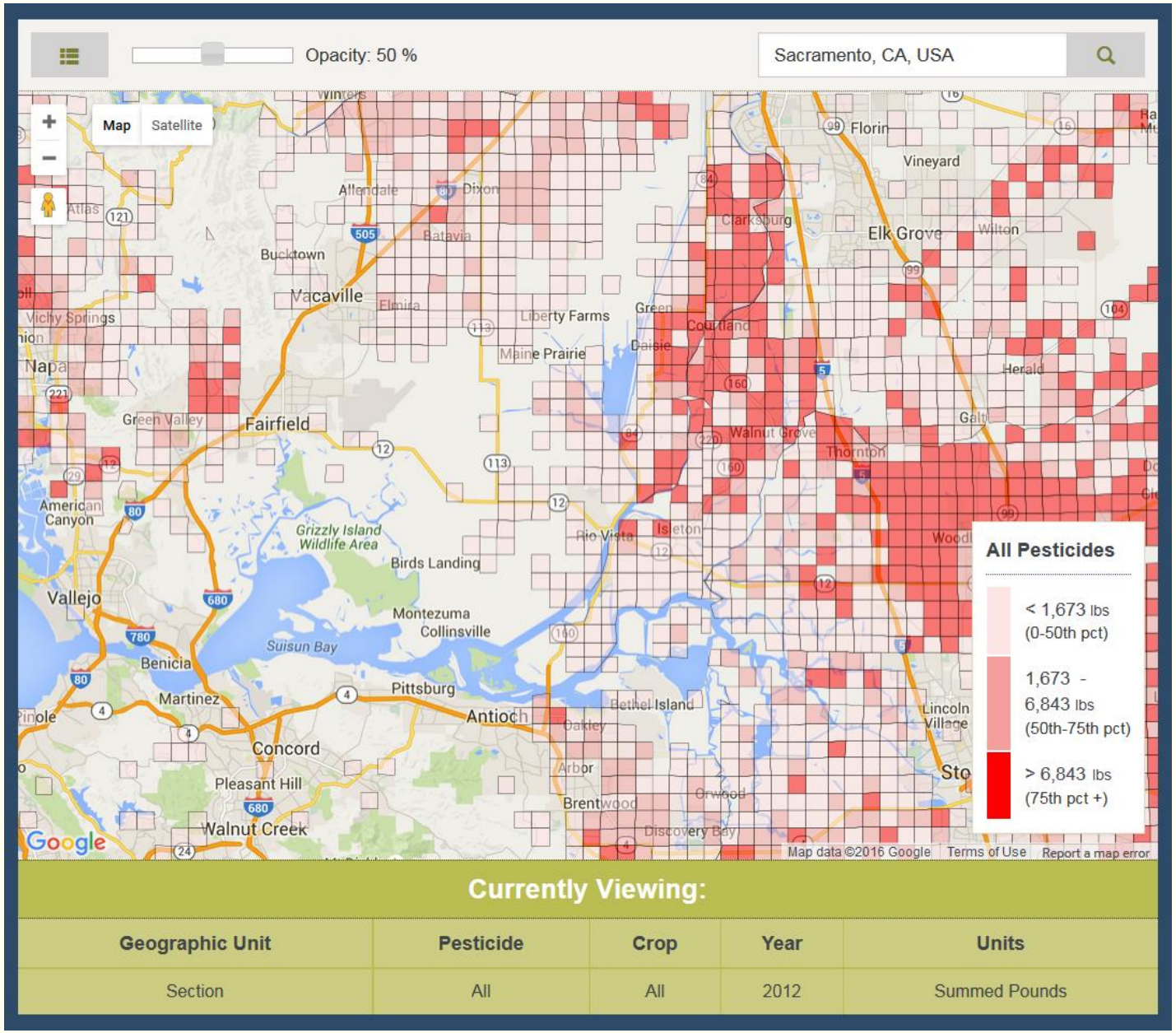
Delta Stewardship Council
Delta Science Program

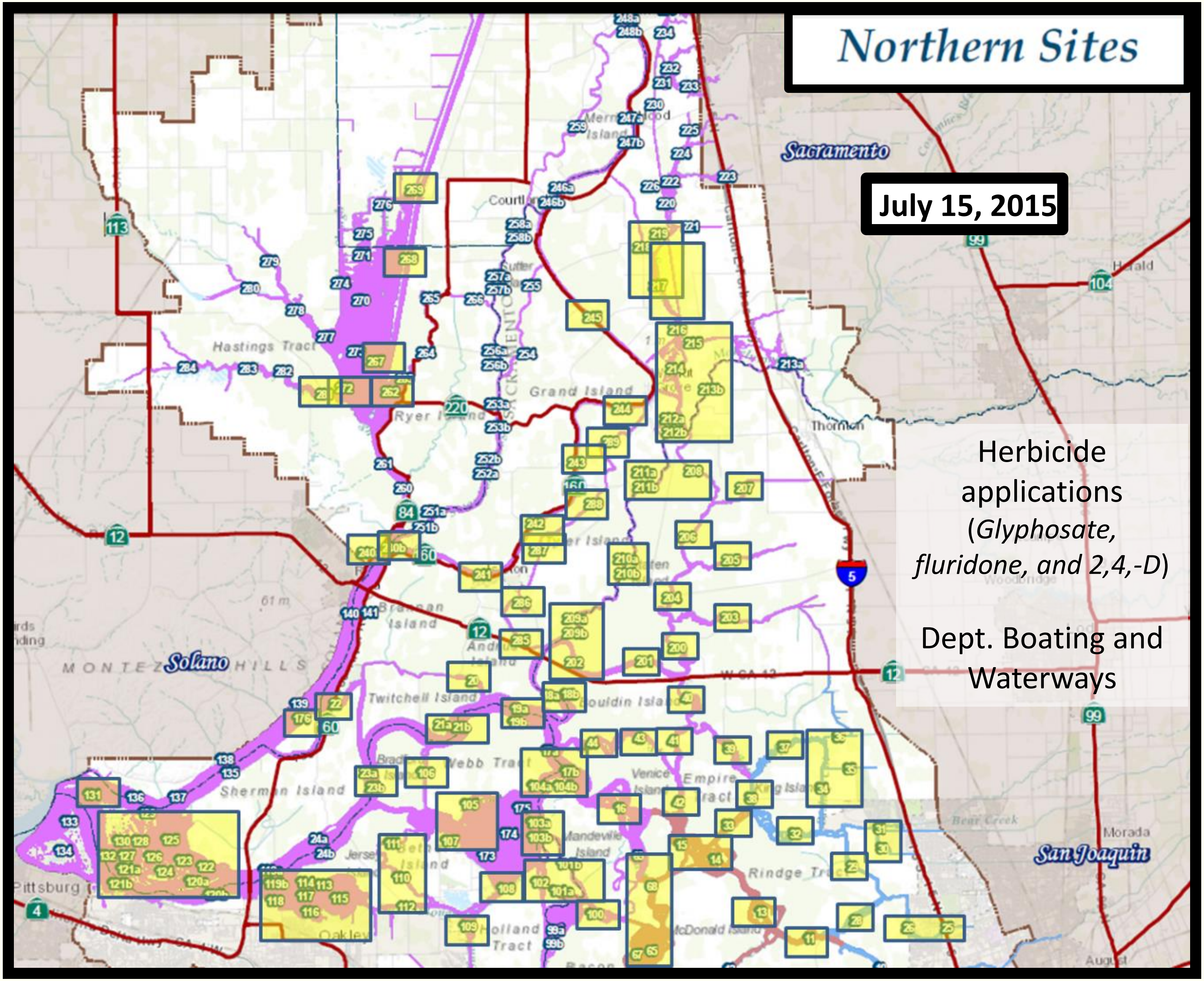
Pesticide Application

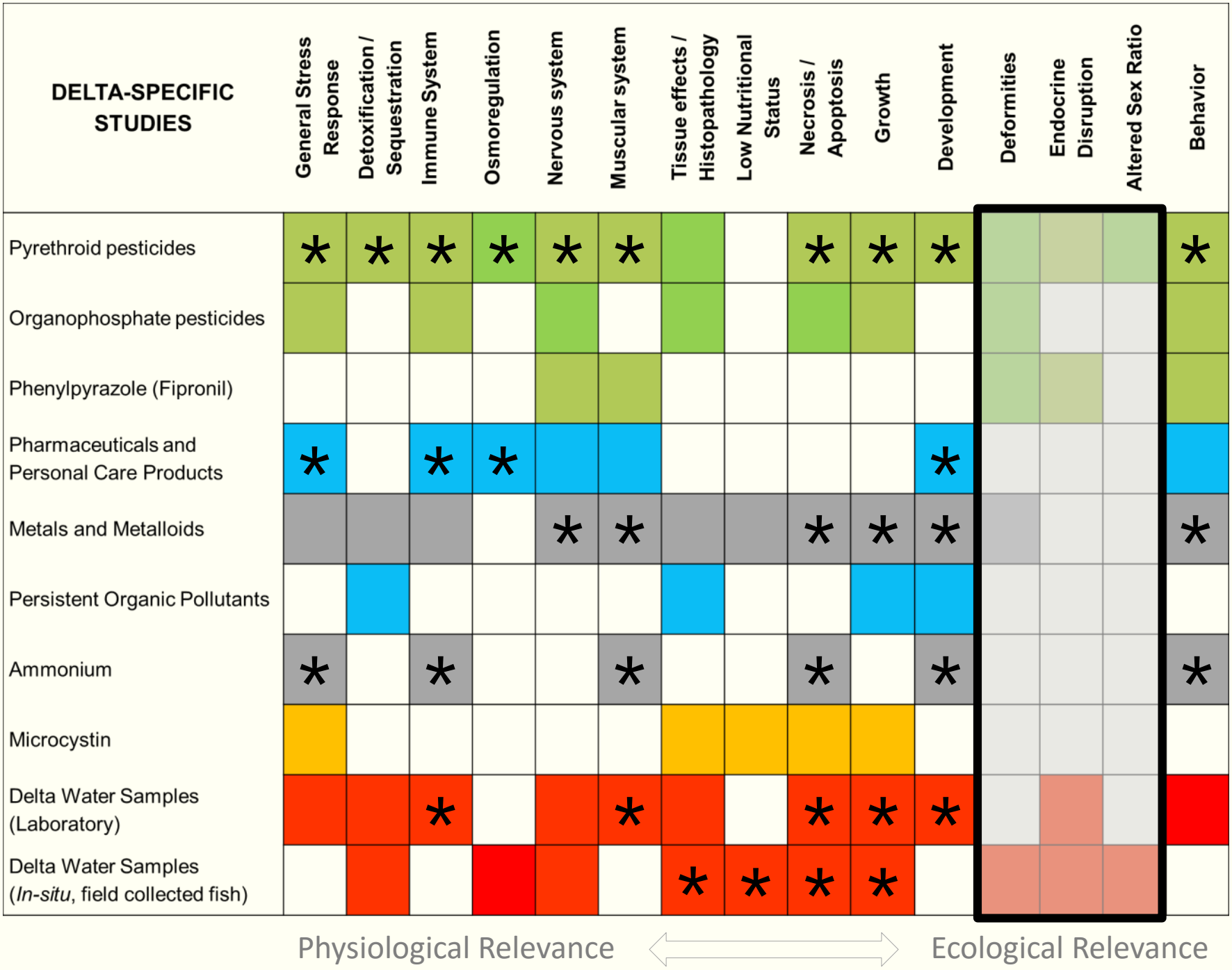
Note: *Agricultural Pesticides only*. Does not include direct applications to surface waters, urban and domestic use

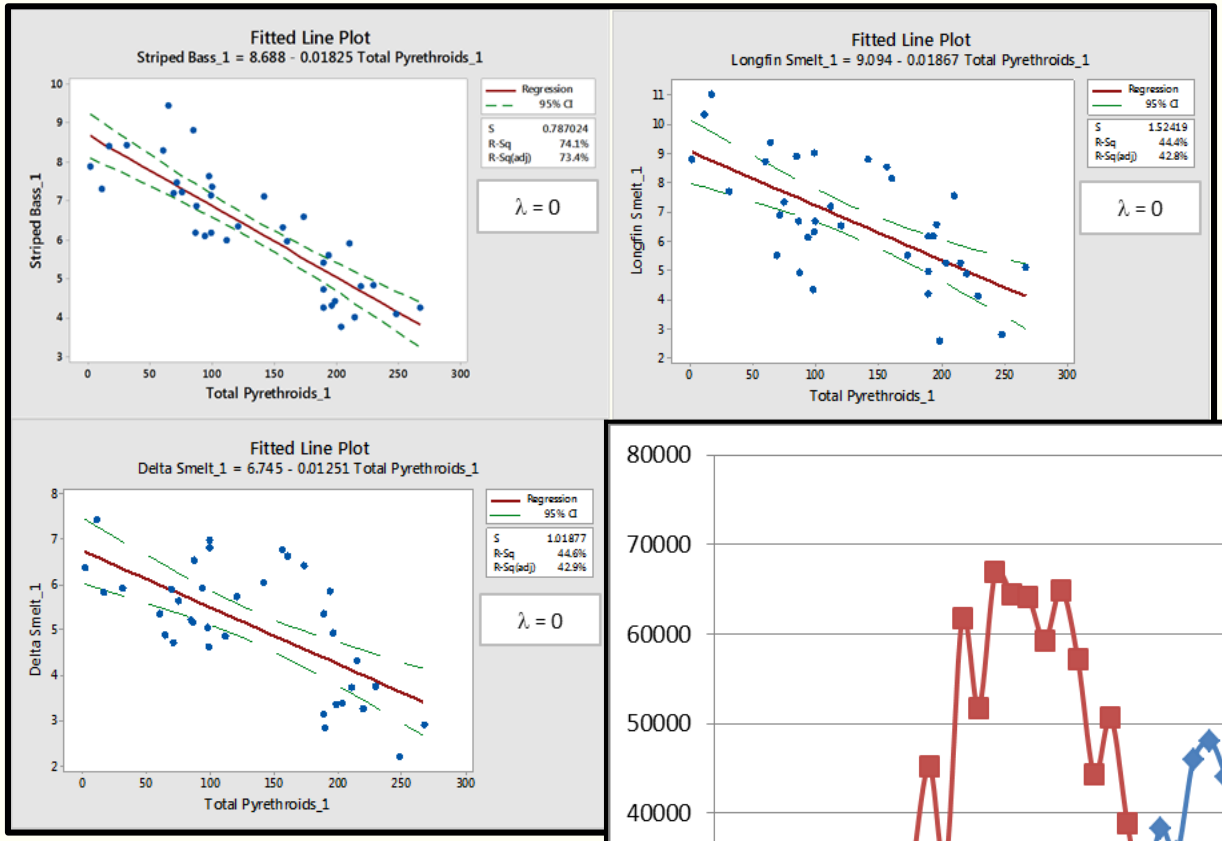
Other contaminants:
Pharmaceuticals and personal care products (PPCPs)
Industrial chemicals
Heavy metals
Legacy contaminants
Organic compounds (e.g., PCBs, PAHs)
Nanoparticles
Plastics
…



Source: http://www.cehtp.org/page/pesticides/agricultural_pesticide_use_in_california. Department of Public Health. Accessed March 28, 2016 (latest dataset: 2012)


Northern Sites
July 15, 2015
Herbicide applications (*Glyphosate, fluridone, and 2,4,-D*)
Dept. Boating and Waterways
Sacramento
Solano
San Joaquin
Hastings Tract
Grand Island
Ryer Island
Brannan Island
Twitchell Island
Sherman Island
Webb Tract
Mandeville Island
Rindge Tract
Holland Tract
McDonald Island
Venice Island
Empire Tract
Thornton
Morada
Pittsburg
Oakley
MONTEZUMA HILLS

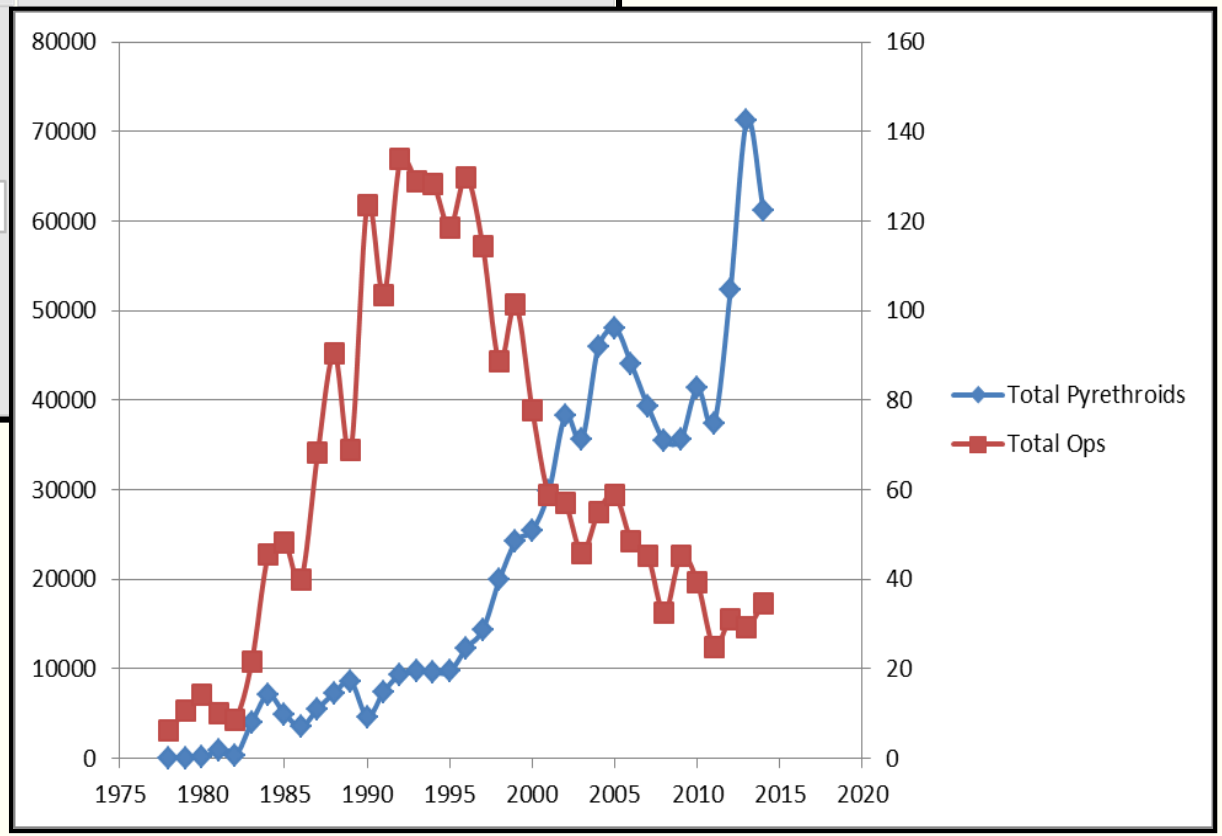

DELTA-SPECIFIC STUDIES
General Stress Response
Detoxification / Sequestration
Immune System
Osmoregulation
Nervous system
Muscular system
Tissue effects / Histopathology
Low Nutritional Status
Necrosis / Apoptosis
Growth
Development
Deformities
Endocrine Disruption
Altered Sex Ratio
Behavior
Pyrethroid pesticides
Organophosphate pesticides
Phenylpyrazole (Fipronil)
Pharmaceuticals and Personal Care Products
Metals and Metalloids
Persistent Organic Pollutants
Ammonium
Microcystin
Delta Water Samples (Laboratory)
Delta Water Samples (In-situ, field collected fish)
Physiological Relevance
Ecological Relevance



<<< Fitted line plots of yearly total pounds of active ingredients of priority pyrethroid pesticides applied to the six counties of the Delta versus yearly FMWT species abundance indices from 1978-2014 (n = 35, no FMWT index was available for 1979). Box-cox transformed data

>>>

Total pounds of active ingredients of pyrethroids and organophosphates applied to the six Delta counties from 1978-2014.

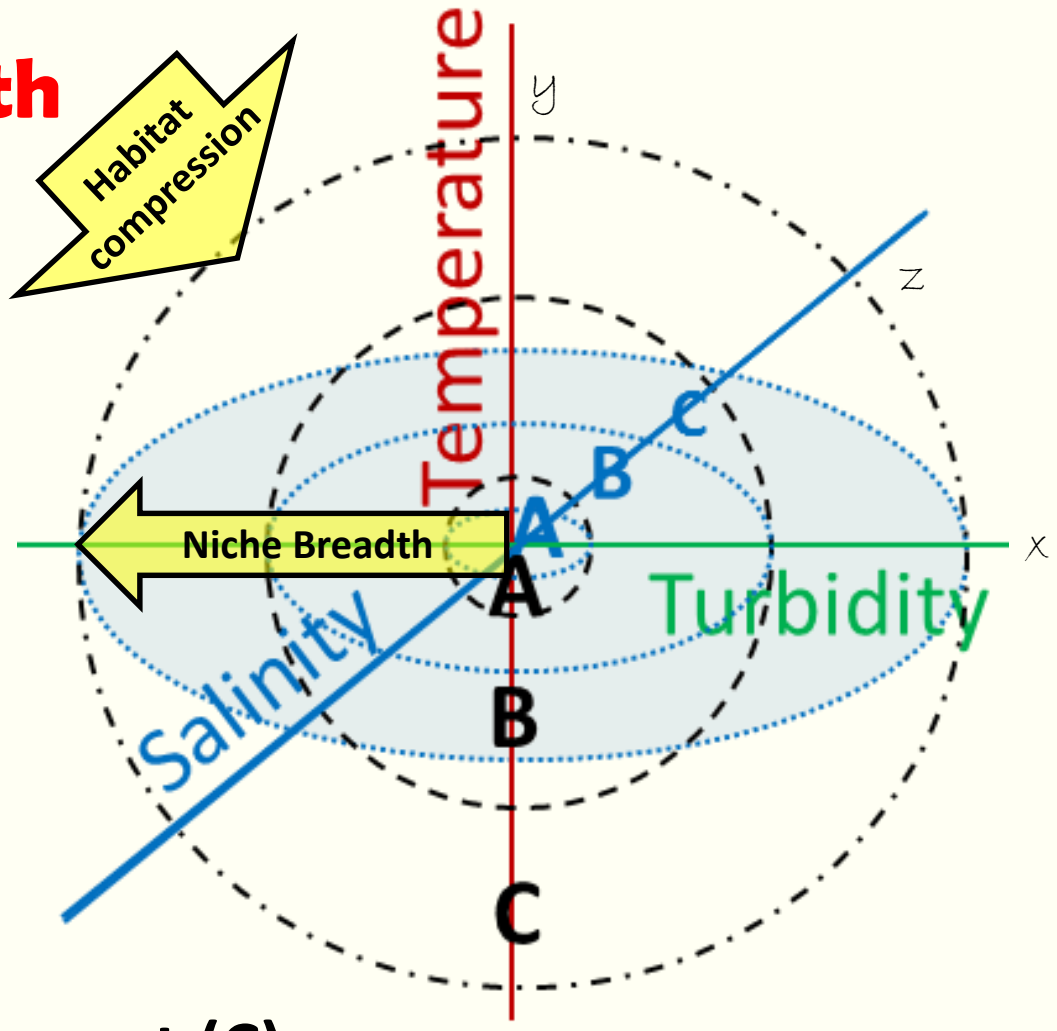


Toxicity varies with habitat and physiological condition

∴

Optimal niche (A) = less sensitive

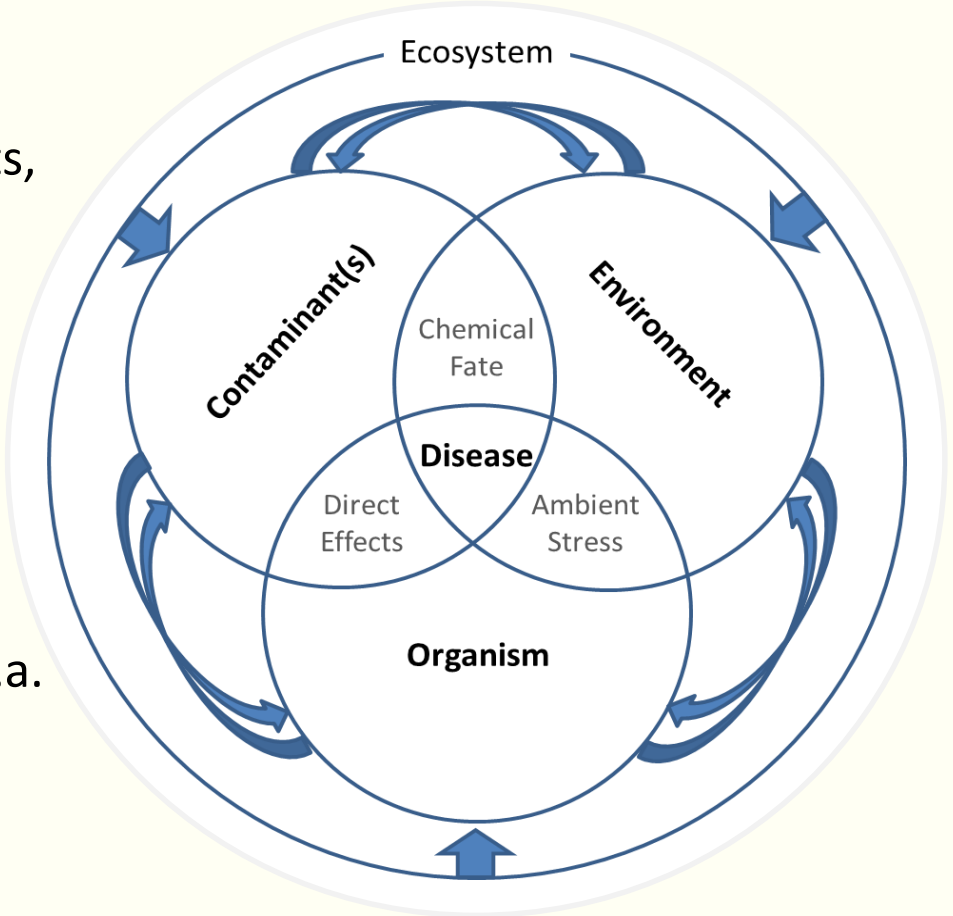
Less optimum environment (C) = more sensitive



Contaminant-Environment-Organism Interactions

- Direct effects (+metabolites, solvents, formulations, herbicides)
- Indirect effects (e.g., via food web)
- Organismal interaction (e.g., disease/predation)
- Habitat modification
- Climate change
- Physicochemical parameters (a.k.a. water quality)

…



What does this mean?

Contaminants impact organisms at multiple levels of biological organization

Environmentally relevant concentrations can and do lead to developmental, behavioral, and reproductive effects

Organisms are exposed to contaminant mixtures, rather than to single chemicals

Mitigation of chemical and sediment runoff can be achieved through best management practices

Sublethal effects can, and do lead to mortality

It is delusional to assume that contaminants play a minor role in the decline of delta species